OVERLAPPING CHAT'S ACCESSIBILITY REQUIREMENTS BETWEEN STUDENTS WITH AND WITHOUT DISABILITIES DUE TO THE MOBILE LIMITATIONS

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ABSTRACT

The use of Chats has been extended to mobile-learning (m-learning) environments in the last decade. Students and teachers can communicate in real time and they do not need waiting till their next tutoring date to solve their problems and doubts. However, Chats have many accessibility barriers and many students cannot use this collaborative tool. These accessibility barriers affect students with disabilities but students without disabilities can face the same accessibility problems due to the restrictions and limitations of handheld devices. Previous studies have improved the accessibility issues of Chats for a specific environment or disabilities but none of them is focused on the limitations that students without disabilities can face when they are using Chats in handheld devices. This is the main aim of this research; specify how the Chats' accessibility requirements have been elicited and analyze the benefits that the obtained requirements can produce for people without disabilities in m-learning contexts.

KEYWORDS

Accessibility; m-learning; handheld devices; Chat; disability; requirements

1. INTRODUCTION

The use of collaborative tools is rising up and students are used to diary use these new environments. One of these collaborative tools is the Chat, which allows students and teachers to exchange instant messages easily. Chats are really useful in m-learning environments for students and teachers to exchange information [1]. However, they present many accessibility problems [2] which do not allow users to use the chat properly and completely. Users with disabilities cannot use them because of barriers such as: problems to follow the flow and rhythm of the conversations [3], problems with the new updated content [4] or problems related to the use of technologies improperly [5]. Furthermore, people without disabilities can experience these problems too because of the limitations and restrictions of handheld devices [6]. For example, if students use a handheld device, they could have problems when they are typing because of the size of the keys in the small keyboard. It is the same problem that people with motor impairments face when they input text in handheld devices or in desktop computers.

This research aims to specify the main accessibility requirements that a Chat should have to be accessible for m-learning environments as well as the benefits that students without disabilities can get when they use Chats in m-learning. Thus, this paper explains how the requirements have been elicited and it also analyzes if these requirements are also useful for people without disabilities who use Chats in handheld devices for m-learning.

This article is divided into the next sections: State of the Art; Requirements for an accessible Chat in m-learning environments and Conclusions. The first section establishes the main accessibility problems of Chats as well as previous Chats which have tried to improve the accessibility. Later, the functional requirements which improve the accessibility for Chats in m-learning environments are specified. And finally, the conclusions and future work about the research are explained.

2. STATE OF THE ART

Many tools such as: blogs, forums or Chats are used to support collaborative learning [7]. One of these collaborative tools, Chat, is a useful tool to communicate with other students or with their teachers in learning environments [8]. However, Chats cannot be used by everybody because of their barriers and because they even have more accessibility problems than other information technologies [9]. Moreover, these problems can affect to people without disabilities too because of the context and use of handheld devices [6]. This section explains the main accessibility problems that Chat's users have as well as previous studies which have tried to improve the Chats' accessibility of learning environments.

3. CHAT ACCESSIBILITY PROBLEMS

Some of these barriers are related to the use of some assistive technologies. If the website auto-refreshes continuously, it causes the screen reader restarts [4] and Braille-display users experience problems because the assistive technology reproduces the new sentences even if the previous sentence has not been spoken completely [10]. Other problems are related to the flow and rhythm of the conversation. Learners with dyslexia, for instance, can feel embarrassed or shamed because they have some interaction problems [11]. Besides, if one of the emitters is not able to write quickly because of his learning disabilities or due to the use of assistive technology as screen readers, they could not be able to follow the conversation [3].

From the point of view of chats in handheld devices, users could experience more restrictions due to the technological limitations of handheld devices [12]. For instance, desktop users with visual impairments can face problems to access to information of the images, if they do not have alternative text as indicated by accessibility standards. This problem is similar to the problems that low band width provokes when images cannot be download and do not have alternative text. Thus, despite using different handheld devices, mobile Web users and impaired desktop users share similar problems [13].

3.1 Previous Accessible Chats

Previous researches try to improve some accessibility problems that users face when they use chats. With regard to the use of chats in e-learning environments like Learning Content Management Systems (LCMS), some LCMSs have tried to implement more accessible chats in their tools. For instance, Moodle 2.3 provides an accessible interface which does not use frames and Javascript technology. Besides, the auto refresh period of time can be specified [14]. Atutor has developed a chat, Achat[1], to solve some technological aspects which can be used by users who use assistive technology and provides functionalities such as: specify the auto refreshing time or refresh messages manually. Furthermore, Blackboard[2] improved the accessibility of its chat creating an Accessible Chat alternative which better support screen readers [15]. Another example of implementation of an accessible chat is the chat provided by eCollege[3] which accomplishes the Section 508 Act and is more usable with assistive technologies [15].

Considering Chats in handheld devices, AssistiveChat[4] provides new features for people with speech disabilities. For instance, the chat suggests words to the user, there are some sentences predefined and it converts the text-to-speech. Moreover, IM prototype [16] specifies the features that a mobile Chat should have such as: presence awareness, asynchronous chat or multi-user chat. However, it does not specify anything related to accessibility. The PictoChat [17] uses a chat in a learning environment through a Nintendo DS console. This chat allows users to write or draw on the screen and communicate with their colleagues but it does not consider accessibility in its design.

These studies try to improve the accessibility of Chats in e-learning and m-learning environments, but none of the previous proposals avoids all the Chat's accessibility barriers. For example, they are focused on specific situations and none of them have tried to improve the accessibility for all students because they are

[1] http://atutor.ca/achat/
[2] http://www.blackboard.com/
[3] http://www.ecollege.com/
[4] http://www.assistiveapps.com

focused on specific disabilities. Furthermore, none of them have specified the main accessibility requirements that an accessible chat should have for e-learning or m-learning environments.

Then, one of the main aims of the research presented in this paper is to study which are the Chat's accessibility requirements for everybody in m-learning environments. Besides, this paper specifies which of them could benefit students without disabilities who experience accessibility barriers because of the handhelds' restrictions and limitations.

4. REQUIREMENTS FOR AN ACCESSIBLE CHAT IN M-LEARNING ENVIRONMENTS

The main requirements that a Chat should have to be accessible in m-learning environments for everybody have been obtained basing on the Human Computer Interaction (HCI) and Software Engineering (SE) disciplines [2].

Moreover, these requirements are analyzed from the point of view of the similarities between web users with disabilities and mobile web users without disabilities; to conclude, if they could be helpful for people without disabilities that use Chat's in m-learning environments. Next sections specify the main SE and HCI techniques used in the elicitation phase as well as the analysis of the functional obtained requirements, which improve the accessibility, for people without disabilities.

4.1 Requirements' Elicitation

Different HCI and SE techniques have been used to obtain the main accessibility requirements that a chat should have to be used in m-learning environments. Both disciplines are combined in order to create more accessible software which involves users in the whole process. The first discipline is needed because this study is part of a research which main goal is to provide a model-based design of an accessible Chat. And the second discipline is used because the research aims to follow a User-centered Design (UCD) involving users in the whole process. Basing on the studies [18] and [18] which specify the main methods used in SE and HCI discipline respectively, the methods which better fit the necessities of this research have been selected.

Firstly, the stakeholders are established and for this research they are teachers and students. They can interact with each other and teachers do not conduct the conversations and way of learning. Thus, students and teachers will be able to execute the same functionalities. Moreover, to obtain a good solution proposal, a specific domain has been chosen to elicit accessibility requirements. Then, the domain is m-learning environments. Next, users have been involved in the elicitation phase and they have participated through questionnaires, user interviews and brainstorming. Other techniques like *Personas* [19] and *Scenarios* [20] have been used to obtain accessibility problems that people could face. Furthermore, existing competitors and systems have been analyzed to obtain the main accessibility problems that they face as well as to check how they have solved specific accessibility barriers. A part from following these techniques, the requirement elicitation is based on standards and guidelines related to learning environments and accessibility such as: Web Content Accessibility Guidelines (WCAG 2.0) [21], Mobile Web Application Best Practices 1.0 [22] or Universal Design Learning [23]. Finally, all the obtained requirements are categorize and classified. Next, the Table 1 shows the methods used and its discipline/s.

Table 1. HCI and SE Methods Used in the Requirements Elicitation Phase

Methods	**HCI**	**SE**
Identify stakeholders and users and stakeholder analysis	✓	✗
Context of use analysis	✓	✗
Brainstorming	✓	✓
User interviews	✓	✗
Questionnaires	✓	✗
Existing system/competitor analyzes	✓	✗
Standards and guidelines	✗	✓
Personas	✓	✗
Scenarios	✓	✗
Categorize requirements	✓	✗

Considering the HCI and SE disciplines and using the techniques specified previously, the requirements for an accessible Chat in m-learning environment have been obtained [2]. Some of these requirements have been improved or added in order to improve the user's experience of students with disabilities. In this paper, we are going to focus on these requirements, the functional requirements which improve the accessibility, see Table 3. Next, these requirements are analyzed to specify if they could be useful for people without disabilities in m-learning environments too.

4.2 Analyses of the Requirements

After obtaining the requirements that a Chat should have to be accessible in m-learning for students with disabilities, they have been analyzed in order to check if they could be beneficial for people without disabilities who use Chats in m-learning.

4.2.1 Overlapped Accessibility Problems for People with and without Disabilities

Basing on the limitations that users with disabilities could have, the restrictions of handheld devices [6] [13] and previous studies which make a parallelism between the problems of people with and without disabilities [24][25][26][27], the Table 2 is created. This table shows the overlapped problems that people with disabilities can have and the problems that people without disabilities could experience in m-learning due to the handheld's limitations when they want to access to the same inaccessible content. Moreover, it is important to emphasize that some of these accessibility barriers are present in old devices only. However, the students sometimes have not the opportunity to have the last generation of mobile devices and software.

Table 2. Accessibility Problems Faced by People with Disabilities that are Similar to the Barriers that People without Disabilities face due to the Handheld Devices Limitations

Problem	**Impairment**	**Handheld**
Color	Colorblind or blind	Limited color palette or sunny places
Large content	Screen magnifier users	Small screen
Multimedia with no captions	Hearing problems	Turn off sound or noisy places
Warnings with audio	Hearing problems	Turn off sound or noisy places
Non-text-objects	Blind user or unsupported technology	Switched off images or unsupported technology
Text Entry	Motor and cognitive disabilities	Small keypad, gloves, unsteady hand or in motion.
Using tables without a logical reading order	Blind user	Small screen and restructured content
Visual information	Blind user	Not CSS support
No keyboard accessible	Motor and visual disabilities	Device has no mouse
Scripting	Not support of scripting	Not support of scripting
Use of plugins	Plugin turned off or not compatible	Plugin turned off or not compatible
Inappropriate page title	Screen reader users	Page title truncated
Content cannot navigated in a logical sequence	Blind and motor impairments	Not pointing devices
Non descriptive link labels	Screen reader users	Link target
Complex language	Cognitive and hearing disabilities	Distracted conditions or in motion.
New windows	Visual and cognitive disabilities	Small screen or distracted conditions
New content	Reading, learning and cognitive disabilities	Small screen, distracted conditions or environments with weak light.
Unsupported markup	Assistive technologies or browsers	Browser
Unsupported scripting	Assistive technologies or browsers	Turned off or not supported
Pointing	Motor and visual disabilities	Small keypad, gloves, unsteady hand, in motion, distracted conditions or eyes-free interactions
Completion times	Motor disabilities	Small keypad, gloves, unsteady hand, in motion or distracted conditions.

As it has been shown, there are many limitations that make users have barriers when they are using their handheld devices. Considering the limitations that people without disabilities could have, Table 2, these limitations could be grouped into:

1) Hardware limitations (HW): Small screen or keypad, not pointing devices, the device has no mouse
2) Software limitations (SW): unsupported technology, browser, scripts, CSS.
3) Content information (Cont.): link target and page title truncated.
4) User necessities or Preferences (UP): turned off images, sounds, or plugins.
5) Environment Limitations (EL): sunny, light, crowd, distracted or noisy environments and user situations like unsteady hand or in motion. In general, places where users' abilities could be reduced.

4.2.2 Improved and Added Functional Accessibility Requirements for Students with Disabilities and for Students without Disabilities in m-learning Environments

Considering the overlapped problems specified in the previous section, it could be indicated that the improved accessible functional requirements for people with disabilities could help students without disabilities to use the Chat in m-learning environments because of the limitations and restrictions of the Chats. For instance, the *Stop Auto Refresh* functionality is useful [28] for people with visual, motor and cognitive or learning disabilities because it allows them to stop the reception of new messages when they are overwhelmed (Related to *New Content problem,* Table 2). Thus, students without disabilities, who are using the Chat in small screens, distracted conditions or environments with weak light could face the same barriers and could get a benefit too.

The *Clean Message* functionality, which allows users to clean all the messages showed on the screen, is another example. The functionality could be useful for screen magnifier users because this assistive technology increases the size of the elements and consequently, the user cannot see all the messages in the screen (Related to *Large Content problem,* Table 2). Users without disabilities could get a benefit of it too when they are using the Chat in a handheld device because of the screen's size.

Next, Table 3 summarizes the accessibility requirements useful for students with disabilities that could be useful for other students in m-learning due to the limitations of handheld devices basing on the overlapped problems specified in the previous section. Besides, it shows the improvements that these requirements provide as well as the problems that they solve basing on Table 2. The following columns specify when these requirements could be useful for the students without disabilities (basing on the categories classified in the previous section).

Table 3. Accessibility Requirements Useful for Students with Disabilities and M-Learning Students without Disabilities

Accessibility Req.	Description	Problems Solved	HW	SW	Cont.	UP	EL
Add an Interlocutor	Students could stop the new interlocutor addition to the conversation.	Large Content Text Entry	✓	✗	✗	✗	✓
Predefined Sentences	Students can select predefined sentences provided by the system.	Text Entry	✓	✗	✗	✗	✗
Add File	The student should specify a description for the uploaded file and the system informs the students about the size's file.	Non-Text Objects	✗	✓	✗	✓	✗
Add URL	The student should specify a summary of the URL and its language to advice other students.	Non descriptive link labels	✗	✗	✓	✗	✗
Stop Auto Refresh and Refresh Conversation	Allow students to pause and refresh the conversation.	New content Completion times	✓	✗	✗	✗	✓
Convert Conversation	Transform the conversation to other formats like audio or	Pointing	✗	✗	✗	✗	✓

Accessibility Req.	Description	Problems Solved	HW	SW	Cont.	UP	EL
	braille						
Last Messages	Show only last messages on the screen	Large Content	✓	✗	✗	✗	✗
Time Refresh	Show new messages in a specific period of time	New content Completion times	✓	✗	✗	✗	✓
Number Messages	Show a specific number of messages on the screen	Large Content New content Completion times	✓	✗	✗	✗	✓
Messages' Order	Show last or new messages at the beginning	New content Completion times	✓	✗	✗	✗	✓
Clean Messages	Allow students to clean the messages which are showed in the screen.	Large Content	✓	✗	✗	✗	✗
Reception Messages	Inform students when the message has been delivered	Not overlapped	✗	✗	✗	✗	✗
Writing	Inform students when other users are writing.	New Content Complex Language	✓	✗	✗	✗	✓
Check Spelling	Inform students about grammatical errors.	Text Entry	✓	✗	✗	✗	✗
Modify User Name	Change large names of students	Non descriptive link labels Large Content	✓	✗	✓	✗	✗
Translate	Translate messages if the sentence language is different to the predefined language.	Complex Language	✗	✗	✗	✗	✓
Show Previous Messages	Allow students to show previous messages	Large Content	✓	✗	✗	✗	✗
Tag Conversation	Catalog the conversations into categories	Large Content	✓	✗	✗	✗	✗

5. CONCLUSION

Creating accessible m-learning environments for students with disabilities is really useful and necessary to protect the persons' rights. It could help to prevent the accessibility barriers that unfortunately still exist in educational environments. However, these improvements could be a benefit also for people without disabilities that can experience the same accessibility barriers because they are using a handheld device.

This research specifies how the Chat's accessibility requirements for m-learning have been elicited and specifies which requirements are useful for students without disabilities who use Chats in m-learning environments due to the restrictions and limitations of handheld devices. For example, the feature which helps users to stop the reception of new messages is useful for students with disabilities and for students who are in distracted conditions or in motion.

In the future, these requirements will be evaluated with users to assure that they are useful for m-learning students without disabilities.

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